

Coelospermum purpureum Halford & A.J.Ford (Rubiaceae), a new species from north-east Queensland

D.A. Halford¹ & A.J. Ford²

Summary

Halford, D.A. & Ford, A.J. (2009). *Coelospermum purpureum* Halford & A.J.Ford (Rubiaceae), a new species from north-east Queensland. *Austrobaileya* **8(1)**: 69–76. *Coelospermum purpureum* Halford & A.J.Ford is described, illustrated and diagnosed against allied species. Notes on habitat, distribution, and conservation status are provided. A key to the species of *Coelospermum* in Australia is presented.

Key Words: *Coelospermum purpureum*, *Coelospermum*, Rubiaceae, Australian flora, Queensland flora, taxonomy, identification key, new species

¹D.A. Halford, c/- Queensland Herbarium, Department of Environment and Resource Management, Brisbane Botanic Gardens, Mt Coot-tha road, Toowong, Queensland 4066, Australia

²A.J. Ford, CSIRO, Sustainable Ecosystems, Tropical Forest Research Centre, P.O. Box 780, Atherton, Queensland 4883, Australia

Introduction

Fertile collections of the species here described as *Coelospermum purpureum* have been in the Queensland Herbarium (BRI) since the 1950s and originally were tentatively identified as *Randia* sp., assumingly as it is a tall shrub or small tree, and later (1990s) listed as *Randia* sp. (Boonjee L.W.Jessup+ GJM264) (Reynolds & Halford 1997). Puttock & Quinn (1999) were not aware of the material and it was not assessed as part of their study of the generic placement of the Australian species of *Randia* L. *sens. lat.* The material was brought to the first author's attention in 2006 by Dr Aaron Davis (K) who was of the opinion that its affinities possibly laid with *Prismatomeris* Thw.

Prismatomeris consist of fifteen species of shrubs and small trees that occur in South-east Asia (Johansson 1987) and was initially placed in the Rubiaceae tribe *Morindeae* Miq. (Hooker 1873). Recent anatomical and molecular studies strongly support the separation of *Prismatomeris* and several closely related genera (*Gentingia* J.T.Johanss. & Wong, *Motleyia* J.T.Johanss. and *Rennellia* Korth.) from the *Morindeae sens. str.* (Igersheim & Robbrecht 1993; Razafimandimbison *et al.* 2008).

The current authors have critically examined the pollen, flowers and fruits of *Randia* sp. (Boonjee L.W.Jessup+ GJM264) and concluded that it belongs in the Rubiaceae tribe *Morindeae sens. str.* and is mostly correctly placed in the genus *Coelospermum* Blume. Johansson (1988) distinguished *Coelospermum* from *Morinda* mainly on pollen-morphological characters 'the lumina of the sexine being much larger in *Coelospermum* with few or numerous luminal processes'. Leaf material of *Randia* sp. (Boonjee L.W.Jessup+ GJM264) was sent by the second author to Dr Sylvain Razafimandimbison (Bergius Foundation, Stockholm) so it could be included in his molecular (*rps16* intron, *trnT-F*, *nrETS* and *nrITS*) studies of the *Morindeae sens. str.* He found that the sample grouped with the other sequenced *Coelospermum* species and resolved as sister to the Australian *C. paniculatum* var. *syncarpum* J.T.Johanss. (Razafimandimbison *et al.*, unpublished data).

The genus *Coelospermum* is distributed throughout South-east Asia, Malesia (including New Guinea), Melanesia and Australia and currently comprises eight species (Johansson 1988; Halford & Ford 2004), most of which are lianas. Two species of *Coelospermum* are recorded for Australia (both lianas), namely *C. paniculatum* F.Muell. and *C. dasylobum*

Halford & A.J.Ford (Forster & Halford 2007). A third Australian species of *Coelospermum*, from north-eastern Queensland, is here described.

Materials and methods

The study is based upon the examination of herbarium material from BRI and CNS (formerly QRS) with field observations by the second author. All specimens cited have been seen by one or both authors. Measurements of the floral parts and fruits of *Coelospermum purpureum* are based on material preserved in 70% ethanol. Common abbreviations in the specimen citations are: L.A. (Logging Area), N.P./R. (National Park/Reserve), S.F.R. (State Forest Reserve) and T.R. (Timber Reserve). The abbreviation RE in the distribution and habitat notes refers to Regional Ecosystem, descriptions of which can be viewed at (in this case); www.epa.qld.gov.au/projects/redd/landzone.cgi?bioregion=7.

Extent of occurrence estimates were derived from the validation of original collection localities. These data points were loaded into ESRI ArcView 3.2 and the draw polygon feature was used to calculate the area between the points. The area of occupation estimates were principally derived from a digital Regional Ecosystem map supplemented by the second author's knowledge of vegetation types and habitats within the Wet Tropics bioregion (referred to as the Wet Tropics hereafter) (Environment Australia 2005).

Taxonomy

Coelospermum purpureum Halford & A.J.Ford, **species nova** similis *C. crassifolio* J.T.Johanss. (a Nova Caledonia) quod saepe format fruticem inflorescentiis paucifloribus floribus pro parte maxima pedicellatis et fructibus pro parte maxima drupis simplicibus praeditis autem foliis tenuioribus atroviridibus in pagina adaxiali marginibus planis (vice foliorum crassorum viridium vel flavoviridium marginibus reflexis) et tubis corollarum longioribus (8–13 mm longis vice 3–7 mm) differt. *Coelospermum purpureum* est plerumque frutex usque arbor parva speciebus ceteris Australiensibus (*C. dasylobo*

Halford & A.J.Ford et *C. paniculato* F.Muell.) dissimile. Differentiae inter *C. dasylobum*, *C. paniculatum* et *C. purpureum* in Tablo 1 instruuntur. **Typus:** Queensland. COOK DISTRICT: Daintree National Park, SE ridge of Mt Hemmant, above Noah Creek, 5 June 2007, A.J. Ford AF5084 & R. Jensen (holo: BRI, iso: CNS; L, MO, NSW *distribuendi*).

Randia sp. (Boonjie L.W.Jessup+ GJM264) (Forster & Halford 2007: 179).

Randia sp. (Boonjee BG5345) (Hyland *et al.* 2003).

Randia sp. (Boonjee) (Cooper & Cooper 2004: 451).

Illustrations: Hyland *et al.* (2003); Cooper & Cooper (2004: 451), as *Randia* sp. (Boonjee).

Bushy shrub to 5 m high (usually umbrella-like) or small tree to 10 m high, stem diameters to 8 cm dbh, glabrous. Bark brown, lacking distinctive features. Wood yellowish, roots brownish. Branchlets laterally compressed (elliptic in transverse section), becoming \pm terete with age; bark on old twigs somewhat flaky, leafy twigs varnished to smooth, purple when fresh; flattened slightly at nodes; raphides present. Leaves petiolate, opposite; stipules interpetiolar, sheathing, 1.5–2 mm long, produced into a narrow triangular lobe, purple when fresh, glabrous, fragmenting as node thickens; petioles 7–15 mm long, purple when fresh; blades discolorous, leathery and thin, narrow-elliptic, sometimes narrow-obovate, 7–15 cm long, 1.9–5 cm wide; adaxial surface shiny or glossy, dark green; abaxial surface much paler than adaxial surface; venation brochidodromous with 5–7 lateral veins per side of midvein; lateral veins slightly raised on both surfaces, slightly more prominent on abaxial surface; tertiary venation not raised; apex acuminate; base cuneate; margins entire; domatia absent. Inflorescence terminal, 2–4-flowered umbel-like, pedunculate dichasium (rarely with an additional 3-flowered umbel-like cyme); peduncle 10–36 mm long, glabrous, terete; bracts *c.* 0.5 mm long, glabrous. Flowers faintly perfumed, (3)4(5)-merous, bisexual; pedicel 7–18 mm long (rarely absent), laterally compressed (elliptic in transverse section),

swollen distally. Calyx tube (including hypanthium) green, 3.5–4.2 mm long, 1.7–2.5 mm across, truncate-urceolate, glabrous, with scattered colleters on rim; calyx teeth irregular, triangular, 0.1–0.2 mm long. Corolla valvate, clavate in bud, deciduous, white at anthesis becoming cream or yellowish-white with age, glabrous on abaxial surface; tube 8–13 mm long, \pm cylindrical, slightly widened at the mouth and constricted at base, fenestrated by short longitudinal splits in lower third of tube, glabrous and papillose on adaxial surface in proximal half but hairy and smooth distally; hairs simple, *c.* 0.5 mm long, white, spreading; lobes spreading and recurved distally at anthesis, narrow-lanceolate or very narrow-elliptic, 9.5–13 mm long, 2–2.5 mm wide, glabrous, acute and \pm cucullate at apex. Stamens always exerted; staminal filaments 2.5–3.1 mm long in long-styled flowers, 5–6 mm long in short-styled flowers, inserted at the sinuses of the corolla lobes; anthers dorsifixed, versatile, linear, 5.8–6.8 mm long, glabrous, with a short mucro at the tip, dehiscing laterally through longitudinal slits. Disc annular, entire, *c.* 0.5 mm high, glabrous. Ovary 2-celled, biovulate; ovules *c.* 0.7 mm long. Long styled flowers with style exerted, 9.7–16 mm long, glabrous; stigma bifid, with spreading lobes 4.5–7 mm long, adaxial surface and margin wrinkled, abaxial surface glabrous. Short styled flowers with style inserted, 6.6–6.9 mm long, glabrous; stigma bifid, with erect lobes 3.8–3.9 mm long, smooth. Fruit a drupe, subglobose to pyriform (due to fleshy apex of pedicel/stipe), \pm laterally compressed, shiny, 14–19 mm long and 11–17 mm across, yellow-orange when ripe, glabrous, persistent calyx tube present but not prominent on surface; pericarp firm, and leathery; mesocarp fleshy, containing four pyrenes. Pyrenes oblong-elliptic in outline, 7–11 mm long, 5–6 mm wide, 2–3.5 mm thick, 1-seeded; endocarp cartilaginous, pale brown, rugose, with an open basal marginal groove. Seed 7–10 mm long, 3–4 mm wide, *c.* 1 mm thick, thickened at one end and tapering to a thin wedge at the other end, with an equatorial ring; testa membranous, dark brown, extended into a flange/wing at one end; endosperm corneous, white; embryo 3.7–5 mm long, straight, surrounded by a clear

and sticky gelatinous membrane; cotyledons 1.6–2 mm long, 0.7–1.1 mm wide, thin, *c.* twice as broad as the radicle; radicle 1.9–3 mm long, 0.5–0.6 mm wide. Germination epigeal (phanerocotylar); cotyledons ovate, 22–31 mm long and 14–18 mm wide, base cordate-obtuse. **Fig 1.**

Additional selected specimens examined: Queensland.

COOK DISTRICT: N.P.R. 212, Mt Finnigan, ridge near Mt Shipton, Oct 1999, *Ford 2290* (CNS); N.P.R. 133, summit of Mt Sorrow ridge walk, site 2, Nov 2000, *Ford 2532 et al.* (CNS); Parish of Alexandra, Little Cooper Creek, Oct 1994, *Gray 5810* (CNS); N.P.R. 133, Daintree, end of Turpentine road, Little Cooper Creek, Nov 2002, *Ford AF3680 et al.* (BRI, CNS); Thornton Peak, west slope, Sep 1992, *Le Cussan 143* (CNS); upper slopes western fall, Thornton Peak, Sep 1986, *Tracey 14992* (CNS); S.F.R. 310 Swipers L.A., Nov 1955, *White [AFO]01317* (BRI, CNS); S.F.R. 310, Windin L.A., Oct 1974, *Hyland 7729* (CNS); Stockwellia site, Boonjee, Jun 1995, *Cooper 944 & Cooper* (CNS); T.R. 1230 Bartle Frere, Boonjee L.A., Nov 1991, *Hyland 14306* (CNS); S.F.R. 755 Boonjee LA (on Bartle Frere Track), Dec 1972, *Hyland 6594* (CNS); SFR 755 Bartle Frere, Boonjee L.A., Mar 1993, *Gray 5645* (CNS); mid slopes western fall Bartle Frere track, Oct 1985, *Tracey 15546* (CNS); S.F.R. 1230 Bartle Frere, Boonjee L.A., Oct 1991, *Gray 5345* (CNS); T.R. 1230, Boonjee L.A., Nov 1987, *Hyland 13327* (CNS); S.F.R. 755 Bartle Frere, Gosschalk L.A., *Gray 6220* (CNS); S.F.R. 755 Bartle Frere, Coolamon L.A., Nov 1990, *Hyland 14085* (BRI, CNS); on the old pack track from Towalla to Chuchabba, Nov 1991, *Jago 720* (CNS); N.P.R. 904 Wooroonoan, along track to Towalla Mine, Sep 2000, *Ford AF2446* (BRI); S.F.R. 755, Elinjaa L.A., Jun 1974, *Irvine 911* (CNS).

Distribution and habitat: *Coelospermum purpureum* is endemic to the Wet Tropics in north-eastern Queensland, where it is currently known to occur from the Cooktown area (Mt Finnigan) to the Topaz-Towalla area on the eastern edge of the Atherton Tableland, near Mt Bartle Frere (**Map 1**). However, within this large range *C. purpureum* is confined to three distinctive and disjunct populations (from north to south):

1. Mt Finnigan area
2. Cape Tribulation area, bounded roughly by Mt Sorrow, McDowall Range, Thornton Peak and Mt Hemmant
3. Towalla – Topaz area, including Mt Bartle Frere.

This species occurs in predominantly the wetter and more mountainous notophyll vine-forests/rainforests on soils derived

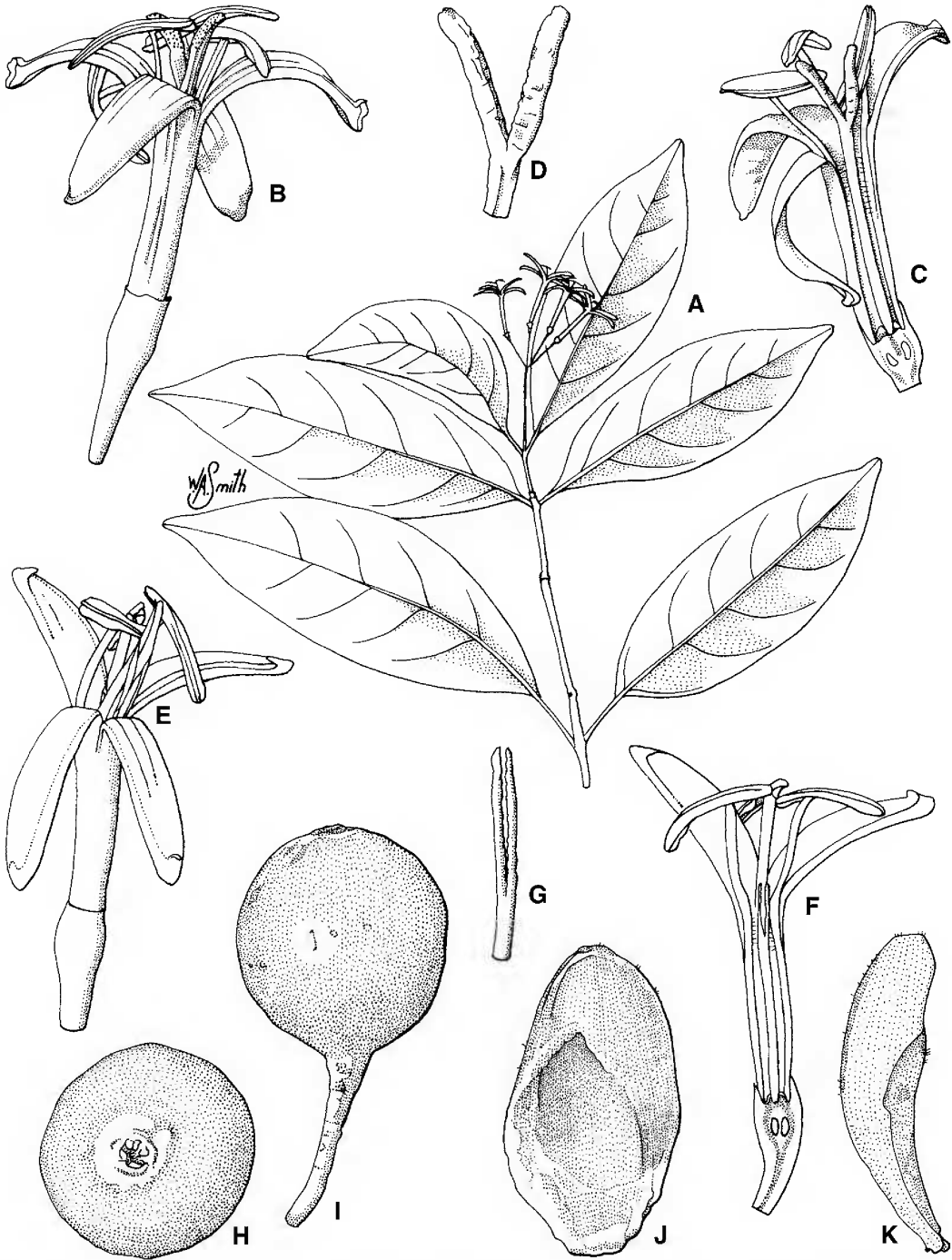


Fig. 1. *Coelospermum purpureum*. A. branchlet with inflorescence $\times 0.6$. B. flower (long styled) at anthesis $\times 3$. C. section of flower (long styled) at anthesis $\times 3$. D. stigma (long styled) $\times 6$. E. flower (short styled) at anthesis $\times 3$. F. section of flower (short styled) at anthesis $\times 3$. G. stigma (short styled) $\times 6$. H. face view of fruit $\times 2$. I. lateral view of fruit $\times 2$. J. adaxial view of pyrene $\times 4$. K. lateral view of pyrene $\times 4$. A from *Forster PIF21984 et al.* (BRI); B–D from *Gray 5345* (CNS); E–G from *Hyland 13327* (QRS); H–I from *Ford AF5084 & Jensen.* (BRI); J–K from *Ford AF3680 et al.* (BRI). Del. W.Smith.

from granite, fine grained metasediments (including mudstone) and basalt. However, it is more commonly encountered on metasedimentary and granitic substrates, with occurrences on basalt being rare. In addition, a specimen has also been recorded as occurring in closed fernland (*Hunter 2192*). Although it occurs over a disjunct geographic area common canopy species include: *Balanops australiana* F.Muell., *Beilschmiedia oligandra* L.S.Sm., *Ceratopetalum virchowii* F.Muell., *Cryptocarya lividula* B.Hyland, *Elaeocarpus elliffii* B.Hyland & Coode, *E. foveolatus* F.Muell., *Flindersia bourjotiana* F.Muell., *Flindersia pimenteliana* F.Muell., *Halfordia kendack* (Montrouz.) Guillaumin, *Musgravea stenostachya* F.Muell., *Sloanea australis* subsp. *parviflora* Coode, *Syzygium endophloium* B.Hyland and *Waterhousea unipunctata* B.Hyland. Common small trees and shrubs throughout most of its range include: *Apodytes brachystylis* F.Muell., *Bobea myrtoides* (F.Muell.) Valetton, *Chionanthus axillaris* R.Br., *Crispiloba disperma* (S.Moore) Steenis, *Pittosporum rubiginosum* A.Cunn., *Polyscias australiana* (F.Muell.) Philipson, *Psychotria* sp. (Danbulla S.T.Blake 15262), *Schistocarpha johnsonii* F.Muell., *Symplocos* sp. (Boonjie B.P.Hyland 2753) and *Wilkiea angustifolia* (F.M.Bailey) J.R.Perkins. Altitudinal range, from existing specimens, is 80–1360 m although there appears to be a preference between 500 m and 800 m.

Coelospermum purpureum has been collected or reliably reported in the following REs: 7.8.2a (rarely); 7.11.12a (commonly), 7.11.12c (occasionally), 7.11.28 (occasionally), 7.11.29a (rarely), 7.11.29b (commonly); 7.12.1a (rarely), 7.12.1c (rarely), 7.12.16a (occasionally), 7.12.19a (rarely) and 7.12.67 (rarely).

Phenology: Flowers have been recorded from October to December; fruits have been recorded from June and July.

Notes: The flowers of *Coelospermum purpureum* have been recorded as “fragrant”, with a “pleasant scent” and with a perfume which “resembles Gardenia and Frangipanni” at anthesis.

A few collections (*Gray 5645* (CNS), *Hyland 13327* (CNS) and *Ford 2290* (CNS)) have seemingly sessile flowers, with the distinctive long and slender pedicel being absent. In these collections the flowers are fused to each others’ bases/hypanthia. This feature occurs in several *Coelospermum* species and is commonly found in *Morindeae sens. str.*, as well as distantly related Rubiaceae tribes (Robbrecht 1988; Razafimandimbison & Bremer 2002; Razafimandimbison *et al.* 2008).

Johansson (1988) acknowledges the genus *Coelospermum* as having a “tendency towards heterostyly”. This condition has been observed in *Coelospermum purpureum* with measurements of androecium and gynoecium for ‘long styled flowers’ and ‘short styled flowers’ being provided above. Field observations indicate that each form is specific to an individual plant and both forms grow in the same area and produce fruit. At this time it is unknown whether *Coelospermum purpureum* is an obligate outbreeder.

Affinities: *Coelospermum purpureum* is morphologically similar to *C. crassifolium* J.T.Johanss. (from New Caledonia) in that the latter often forms a shrub, has few-flowered inflorescences with mostly pedicellate flowers and has mostly simple drupaceous fruits. *Coelospermum purpureum* differs in having thinner leaves that are dark green on the adaxial surface (compared with thick leaves that are green or yellowish-green in *C. crassifolium*), leaf margins flat (reflexed in *C. crassifolium*) and longer corolla tubes (8–13 mm long compared with 3–7 mm long in *C. crassifolium*). Unlike the other species of *Coelospermum* in Australia (*C. dasylobum* Halford & A.J.Ford and *C. paniculatum* F.Muell.), *C. purpureum* is usually a bushy shrub to small tree. A comparison of diagnostic differences between *C. dasylobum*, *C. paniculatum* and *C. purpureum* is provided in **Table 1**.

Table 1. Morphological comparison between *C. dasylobum*, *C. paniculatum* and *C. purpureum*.

Character	<i>C. dasylobum</i>	<i>C. paniculatum</i>	<i>C. purpureum</i>
habit	twining vine or scandent shrub with long arching stems	liana	bushy shrub to small tree
corolla tube length	5–7 mm	3–6 mm	8–13 mm
corolla lobes	densely hairy adaxially	glabrous	glabrous
corolla lobes length	5–7.5 mm	6–7 mm	9.5–13 mm
young stems and inflorescences branches	glabrous	hispidulous	glabrous
fruit colour	yellow-orange to yellow-brown	red to purple	yellow-orange
fruit form	compound syncarpous drupe	simple drupe or compound syncarpous drupe	simple drupe rarely compound syncarpous drupe
inflorescence	many-flowered paniculate umbel-like dichasial cymes or rarely axillary dichasial cymes	many-flowered paniculate umbel-like dichasial cymes or rarely axillary dichasial cymes	2 to 4-flowered umbel-like, pedunculate dichasia
tertiary venation on lower leaf surface	raised	not raised	not raised
domatia	present	present	absent

Key to the species of *Coelospermum* in Australia

- 1 Shrub or small tree, erect, flowers usually simple and on long and slender pedicels **C. purpureum**
1. Woody vine, twining or scandent, flowers usually arranged into dense, many flowered clusters **2**
- 2 Young stems glabrous; corolla lobes densely hairy on adaxial surface **C. dasylobum**
2. Young stems with fine short hairs; corolla lobes glabrous on adaxial surface. **C. paniculatum**

Conservation status: Most existing collections of *Coelospermum purpureum* have been made within the World Heritage Area of the Wet Tropics. *Coelospermum purpureum* has been collected in Cedar Bay, Daintree and Wooroonooran National Parks. It has a wide, but restricted and disjunct geographical range,

with an extent of occurrence estimated to be 680 km² and an area of occupation estimated to be 550 km²; however, it is not considered at risk at this time. This is despite *C. purpureum* fulfilling some of the Geographical Range criteria of IUCN (2001), viz. VUB1 or VUB2, however there is no evidence to support a

projected or inferred decline in population numbers as the vast majority of the Extent of Occurrence is within the Wet Tropics World Heritage Area. In addition, *C. purpureum* is a dominant and common shrub where it occurs, with the exceptions being at the extremes of its altitudinal range.

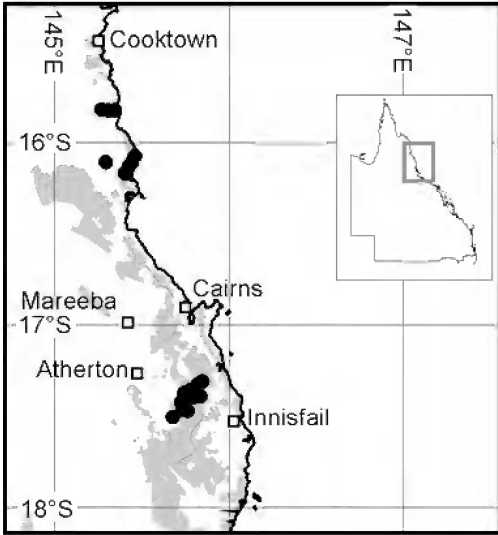
Etymology: The specific epithet, from Latin *purpureus*, purple, refers to the colour of the leafy twigs, stipules and petioles of this species, when fresh.

Acknowledgements

The authors wish to thank Will Smith for the illustration; Peter Bostock for providing the distribution map; Les Pedley for the translation of the diagnosis into Latin; Aaron Davis for bringing this species to our attention; Sylvain Razafimandimbison for comments on the species relationships. Wendy Cooper and Helen Murphy gave generously of their time providing field assistance. Permits to collect in the “Wet Tropics” were issued by the Environmental Protection Agency. The curators and staff at BRI and CNS (formerly QRS) are thanked for allowing access to specimens and the use of their facilities.

References

- COOPER, W. & COOPER, W.T. (2004). *Fruits of the Australian Tropical Rainforest*. Nokomis Editions: Melbourne.
- ENVIRONMENT AUSTRALIA. (2005). Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1 – Summary report (2000). Updated, IBRA Version 6.1 (Digital Data, metadata). [accessed 24 June 2009]. <http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/>.
- FORSTER, P.I. & HALFORD, D.A. (2007). Rubiaceae. In P.D.Bostock & A.E.Holland (eds.), *Census of the Queensland Flora 2007*, pp. 175–179. Environmental Protection Agency: Brisbane.
- HALFORD, D.A. & FORD, A.J. (2004). *Caelospermum dasylobum* (Rubiaceae), a new species from north-eastern Queensland. *Austrobaileya* 6: 911–915.
- HOOKE, J.D. (1873). Rubiaceae. In G.Bentham & J.D.Hooker, *Genera Plantarum* Volume 2. L. Reeve & Co.: London.
- HYLAND, B.P.M., WHIFFIN, T., CHRISTOPHEL, D.C., GRAY, B. & ELICK, R.W. (2003). *Australian Tropical Rain Forest Plants. Trees, Shrubs and Vines*. CD-ROM. CSIRO publishing: Melbourne.
- IGERSHEIM, A. & ROBBRECHT, E. (1993). The character states and relationships of the Pristomerideae (Rubiaceae-Rubioideae). Comparison with *Morinda* and comments on the circumscription of the Morindeae s.s. *Opera Botanica Belgica* 6: 61–80.
- IUCN (2001). *IUCN Red List Categories: version 3.1*. IUCN Species Survival Commission. IUCN: Gland, Switzerland
- JOHANSSON, J.T. (1987). Revision of the genus *Pristomeris* Thw. (Rubiaceae, Morindeae). *Opera Botanica* 94: 1–62.
- (1988). Revision of the genus *Caelospermum* Blume (Rubiaceae, Rubioideae, Morindeae). *Blumea* 33: 265–297.
- POTTOCK, C.F. & QUINN, C.J. (1999). Generic concepts in Australian Gardenieae (Rubiaceae). *Australian Systematic Botany* 12: 181–199.
- RAZAFIMANDIMBISON, S.G. & BREMER, B. (2002). Phylogeny and classification of Naucleae (Rubiaceae) inferred from molecular (nrITS, *rbcL*, and *trnT-F*) and morphological data. *American Journal of Botany* 89: 1027–1041.
- RAZAFIMANDIMBISON, S.G., RYDIN, C. & BREMER, B. (2008). Evolution and trends in the Psychotriaceae alliance (Rubiaceae) – A rarely reported evolutionary change of many-seeded carpels from one-seeded carpels. *Molecular Phylogenetics and Evolution* 48: 207–223.
- REYNOLDS, S.T. & HALFORD, D.A. (1997). Rubiaceae. In R.J.F.Henderson (ed.), *Queensland Plants: names and distribution*, pp. 180–184. Department of Environment: Brisbane.
- ROBBRECHT, E. (1988). Tropical woody Rubiaceae. *Opera Botanica Belgica* 1: 1–271.



Map 1. Distribution of *Coelospermum purpureum* • in north-east Queensland. Shaded area on map indicates nature conservation reserves (National Parks, Forest Reserves and Conservation Parks).